DOCUMENT OF THE INTER-AMERICAN DEVELOPMENT BANK

BRAZIL

TECHNOLOGICAL INNOVATION AND NEW MANAGEMENT APPROACHES IN AGRICULTURAL RESEARCH – AGROFUTURO

(BR-L1001)

LOAN PROPOSAL

This document was prepared by the project team comprising: Adriana Delgado, Team Leader (RE1/EN1); Francisco B. F. de Souza (RE3/EN3); Rubén Echeverría (SDS/RUR); Luis Macagno (COF/CBR); Paula Giraldez (LEG/OPR); and Alexandra Ortega (RE1/EN1).

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PROJECT SUMMARY

Brazil

Technological Innovation and New Management Approaches in Agricultural Research

Project Summary				
Date: 20 July 2004			Project No.	BR-L1001
Project Team: Adriana Delgado, Team Leader (RE1/EN1); Francisco B. F. de Souza (RE3/EN3); Rubén Echeverría (SDS/RUR); Luis Macagno (COF/CBR); Paula Giraldez (LEG/OPR); Cristina Price (LEG/OPR); and Alexandra Ortega (RE1/EN1).			Loan instrument:	Investment loan
			Sector(s)	AG
			Date of CESI review:	19 March 2004

Financial terms and conditions [1]				
Borrower: Federative Republic of Brazil			Amortization period:	20 years
Guarantor:			Grace period:	5 years
Executing agency: Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)			Disbursement period:	5 years
Sources	Quantity	Percentage	Interest rate:	Adjustable
IDB (OC)	33,000,000	55%	Inspection and supervision fee:	0%
Local	27,000,000	45%		
Other/cofinancing			Credit fee:	0.25%
Total	60,000,000	100%	Currency:	Libor US$

Project scheme

Project objective:

To strengthen the capacity of the agricultural innovation system in strategic areas that are critical to agricultural and rural development.

Special contractual conditions:

Conditions precedent to the first disbursement: In addition to the usual contractual conditions, the following special conditions will apply, as specified in paragraphs: 3.1; 3.5; 3.11; 3.40; 3.20; 3.24; and 3.7.

(i) Signature of a program execution agreement between MAPA and EMBRAPA (paragraph 3.1)

(ii) Creation of the PCU and appointment of its members (paragraph 3.5)

(iii) Implementation of the Operating Manual for component 1 and incorporation of the component 1 management module into the monitoring and evaluation system (paragraphs 3.11 and 3.40)

(iv) Signature and entry into force of contracts with USDA/ARS, Agrópolis of Montpellier, and CIAT, and with IICA for management of program consulting services, in accordance with the model agreed with the Bank (paragraphs 3.24 and 3.7)

Special execution conditions: See paragraphs 3.20 and 3.40. (i) The agreements between EMBRAPA and the organizations participating in the three family agriculture clusters, as per a model agreed with the Bank, must be signed and published prior to disbursement of more than 10% of the total loan amount (paragraph 3.20); and (ii) the program monitoring and evaluation system must have been implemented prior to disbursement of more than 20% of the total financing (paragraph 3.40).

Exceptions to Bank policies: See paragraphs: 3.32, 3.33, and 3.34.

For execution of the component in support of regional and international integration, an exception to competitive bidding is proposed to allow direct contracting of USDA-ARS, Agrópolis of Montpellier, France, and the International Center for Tropical Agriculture (CIAT) in Cali, Colombia. An exception to bidding procedures will also be requested to allow IICA to be hired to manage the program's consulting services.

Project consistent with country strategy:	Yes [X]	No [ ]			
Project qualifies as:	SEQ [ ]	PTI [ ]	Sector [ ]	Geographic [ ]	% of beneficiaries [ ]
Procurements: See paragraphs: 3.31 and 3.34					

[1] The interest rate, credit fee, and inspection and supervision fee specified herein are established in accordance with document FN-568-3-REV, and may be altered by the Board of Executive Directors in accordance with the six-monthly recommendation issued by the Finance Department. In no case may the credit fee exceed 0.75%, or the inspection and supervision fee be greater than 1% of the loan amount. (*) (*) In the case of the inspection and supervision fees, under no circumstances may the charge in any six-month period exceed 1% of the loan amount divided by the number of six-monthly periods envisaged in the original disbursement period.

I. FRAME OF REFERENCE

A. The agriculture sector in Brazil

1.1 Brazil's agrifood sector is of major economic and social importance as a provider of food, source of employment, and foreign exchange earner; and it forms the basis for settlement and development of national territory, even though the country has undergone rapid industrialization and urbanization. Brazil's generous endowment of natural resources for primary production, combined with dynamic technological and management innovation in modern farming operations, have made the production of soybeans, sugar, coffee, citrus fruits, and meat highly competitive on world markets. That the agrifood sector has outpaced the rest of the economy and is the only sector to display sustained growth is a reflection of its comparative advantages in the new open-economy setting (agricultural GDP increased by 5% in 2002 and 5.5% in 2003, compared to 1.3% and 0.2%, respectively, improvements in GDP for the economy as a whole).

1.2 In 2000, the agrifood sector accounted for nearly 27% of GDP, with primary production representing 7%. The sector provides employment to 27% of the labor force, or 18 million workers, surpassing manufacturing industry and commerce; and it contributes over 40% of the country's exports, concentrated in a small range of products. Actions to promote development of the agrifood sector have a direct impact on the performance of the Brazilian economy and the welfare of a large contingent of the country's population.

1.3 The Brazilian agribusiness sector is increasing its share of exports on the basis of better quality; and traditional export product lines are now being joined by high-value products such as tropical fruits. This diversification requires strengthening of the research and development (R&D) system in new thematic areas, in response to heightened competition in markets that are dominated by an ever smaller group of large transnational enterprises, and the need to develop differentiated technologies that make national output more competitive.

1.4 Although a sizeable group of producers that are well established in product and input markets have made progress on the technological and management fronts, most small-scale producers remain in traditional product lines with low levels of productivity and income. The major potential of family agriculture is demonstrated by its contribution to the gross production value of milk, pigs, cassava, beans, bananas and a range of fruits and vegetables. Of the 4 million family farms in Brazil, 53% sold more than half of their output value in 1995.

1.5 The most dynamic family farmers are those that have joined regional and national production chains; and the most successful settlements in the south of the country are members of competitive clusters with consolidated channels for production marketing and processing, and technological support. Even allowing for a substantial transfer of income to other links in the chain, the incomes earned by

these producers are higher and more stable, and afford their families a better standard of living.

1.6 Most Brazilian family farmers have to cope with fluctuating and low-price wholesale markets, with poorly integrated technical assistance services and low coverage, provided by various programs and institutions at the three levels of the public sector (federal, state, and municipal). In a globalized economy, these producers face increasing demands for quality, and adaptable production systems capable of satisfying demands for differentiated products in specific market niches; this requires support services and integration into agrifood chains.

1. The research and development (R&D) system

1.7 Over the last four decades, Brazil has made major strides to develop its agricultural R&D capacity, overtaking other countries in the region and approaching European levels (Portugal, Spain, Italy, and Ireland). In 1996, total R&D expenditure accounted for 0.75% of GDP – a figure slightly higher than in Chile and twice the level prevailing in Argentina and Mexico. Investment in research amounted to US$1.70 for every US$100 of agricultural GDP in 1996, and employed about 5,000 full-time researchers. Brazil (along with China and India) has managed to establish one of the largest systems of agricultural innovation in the developing world.

1.8 Despite this progress, the country's private sector needs to become more proactive in generating technological innovation. In 1999, just 35% of patent applications filed with the National Industrial Property Institute (INPI) came from Brazilian residents. Although the private sector provides a significant share of R&D financing (33%), this is well below the average of 63% among member countries of the Organization for Economic Cooperation and Development (OECD). Approval of the Industrial/Intellectual Property Act in 1996 was a fundamental step to correct this shortcoming; and was complemented by the Plant Variety Protection Act in 1997. Although these laws have made it easier to set up enterprises mainly for the production of maize and soybean, private R&D investment in this sector remains relatively low. This situation represents a challenge for the Brazilian Agricultural Research Enterprise (EMBRAPA) to achieve closer ties with the domestic private sector, and for Brazilian enterprises themselves to invest more in R&D, either directly or by hiring research services.

1.9 EMBRAPA is the cornerstone of R&D in the agricultural sector, accounting for 60% of financial resources and 41% of the country's researchers. It was created in 1972 as an autonomous public enterprise attached to the Ministry of Agriculture and Supply, with responsibility for applied research in the crop, livestock, forestry, agribusiness, and natural resource management sectors.

1.10 EMBRAPA coordinates the National Agricultural Research System (SNPA), which was created in 1991 and comprises State Agricultural Research Organizations (OEPAs), universities, research institutes at federal and state level, and private-

sector organizations. The goals of the SNPA are as follows: (i) to ensure that agricultural research guidelines and strategies are compatible with national and regional development policies; (ii) to coordinate research and avoid duplication of efforts; (iii) to support the development of a research planning, monitoring, and evaluation system; (iv) to establish a Brazilian agricultural information system that enables users to gain access to research; and (v) to promote joint execution of projects, information exchange, and technical support among the system's institutions.

1.11 The institutional autonomy enjoyed by EMBRAPA has contributed to a technical style of management that is relatively immune to political pressures; it has also created conditions for the institution to become the regional leader and one of the pre-eminent tropical agriculture research institutions worldwide. The institution runs an ambitious training program for its staff, with support from IDB and the World Bank; and the existence of an attractive environment and working conditions for its employees has enabled it to achieve a high rate of return on human capital investment, as reflected in the fact that nearly all its research staff have postgraduate training, and roughly half of them hold doctorates.

1.12 EMBRAPA has introduced management changes aimed at stimulating productivity, customer orientation, and efficiency in the use of its resources. Such efforts include implementation of a system of evaluation and remuneration by results for research units, project teams, and individual researchers; and greater receptiveness to the demands of producers and participants in agrifood chains. The index of research center institutional performance has demonstrated continuous improvement, based on a wide range of indicators such as meeting production targets (technical publications, development of varieties, software); obtaining resources and using them efficiently; and quality appraisal by a high-level technical commission.

1.13 Since the 1980s, EMBRAPA has shown special concern for achieving and documenting economic impacts, such as genetic improvements in soybeans, maize, rice, and beans; pest management in soybeans; and the introduction of irrigation in maize growing. It has also made a major contribution to progress on plant nutrition and in bringing into production extensive land areas previously considered unproductive *(cerrados)*.

1.14 The institution has also worked to promote natural resource conservation and environmentally sustainable production, by developing technologies in the field of organic production, direct sowing (which protects against erosion), biological pest control, introduction of plant and animal varieties adapted to agroecological conditions, development of systems for managing organic animal wastes, rainwater capture for irrigation, and good environmental practices in aquaculture, and other technologies.

1.15 In addition to organizations attached to the federal government, there is considerable R&D capacity in the states (37% of researchers in 1996), although this

is very unevenly distributed. The 1988 Constitution transferred to the states a substantial portion of the fiscal resources previously managed by EMBRAPA for supporting OEPAs, but without identifying a specific use. This resulted in a steady decline in R&D funding in most states, and currently only 16 OEPAs are operating in the country's 26 states.

2. Challenges and opportunities facing the R&D system

1.16 Consolidating an adequate agrifood R&D system is a high priority for Brazil, given the system's economic importance in responding to the demands for products of higher quality and value on domestic and international markets; supporting the development of agrifood chains; generating employment with favorable distributive impacts; and alleviating poverty in both rural and urban areas.

1.17 Trends on international markets toward more healthy products pose technological challenges that require a major management effort, thereby affording competitive advantages to technology-based family production, as a link in well integrated agrifood and agribusiness chains. Organic agriculture and tropical fruit growing are examples of new product lines where technological shortcomings need to be overcome, in order to attain a level of competitiveness that allows greater market penetration and vigorous expansion in high-income countries.

1.18 Progress therefore needs to be made in meeting the new technological challenges facing Brazilian agriculture, bearing in mind that public technologies that generate widely dispersed and hard-to-appropriate benefits, represent an ever smaller subset of the technological products available. The public sector thus needs to achieve a much more strategic positioning than the one that resulted in the current structure of technological innovation.

1.19 The increased private-sector share of R&D, particularly in developing new varieties, and the increasing reliance of technological development on knowledge and inputs subject to protected intellectual property rights, call for more flexible institutional arrangements. Thus, EMBRAPA needs to focus more on solving problems with research clusters and networks, creating conditions to promote private-sector participation in project financing, and the protection and marketing of its technological production.

1.20 The R&D system needs to consolidate a balanced funding structure that combines resources from competitive funds, technological development contracts, and royalties, with an institutional budget that provides the stability needed to carry out training and infrastructure investments, and to finance resources in long-term strategic projects. EMBRAPA has increased its income from non-Treasury sources to roughly 13% of its total budget – an amount that compares favorably with similar institutions in other countries. Strengthening of EMBRAPA capacity and competitiveness will make it easier to attract resources from competitive funds abroad to finance project operating costs, enabling it in the medium term to

reallocate an increasing share of its budget toward institutional development and investments in training and infrastructure.

1.21 A special challenge is posed by technological demands arising from programs such as agrarian reform, family agriculture, and prevention of hunger, most of which require more rapid transfer of the technologies generated by EMBRAPA. To meet that rising demand, which requires additional technologies among other important factors, a new model will need to be put in place with tighter integration and closer collaboration between the technology generation and transfer stages. This requires institutional organizational structures that facilitate the application of management models and technologies that address the specific interests and conditions of small-scale producers.

> The criteria used in Brazil to characterize family farmers are as follows: (i) the producer also administers the farm; (ii) family labor outweighs hired labor; and (iii) the size of the property cannot exceed a pre-established limit for each region.

1.22 In the technical-cooperation domain, EMBRAPA is consolidating a pioneering initiative aimed at improving access to scientific and technological progress in more advanced countries. This involves setting up Virtual Laboratories Abroad (LABEX) – in the United States through an association with the Agricultural Research Service of the US Department of Agriculture (ARS/USDA), and in France with Agrópolis (Montepellier).

B. The country's strategy in the sector

1.23 The federal government is promoting rural development through the 2004-2007 multiyear plan (PPA), with investments in infrastructure and in the productive and social areas. A major part of these investments will target the country's tropical zones, mainly in the south of Amazonia, the northeast and the *cerrados* region, in the hope that this will boost demand for specific technologies in short supply in these regions. The government has targeted small-scale owners, through programs such as the Family Agriculture Support Program (PRONAF), Agrarian Reform, and Food Security (Zero Hunger). Among other factors, the success of these programs will depend on the existence of new technologies suited to small-scale producers, enabling them to become more competitive in high-value products and to join agribusiness productive chains.

1.24 Although the government has prioritized family agriculture as a tool of equity and job creation, that does not mean less attention is now being paid to ongoing improvement of agribusiness competitiveness internationally by incorporating state-of-the-art technologies. **Incorporation of new technologies is fundamental to ensure that the whole agrifood-agribusiness complex maintains its current dynamism.** Accordingly, the government has prioritized programs aimed at improvement of plant and animal genetics; application of biotechnology in areas relating to the use and conservation of natural and farming resources; monitoring

and mitigating actions in at-risk ecosystems, natural resource management in crop-growing and livestock-breeding areas and agricultural systems related to family farming. This emphasis is being and will continue to be implemented in a framework of natural and agricultural resource conservation.

C. The Bank's strategy with the country and sector

1.25 The Bank's strategy identifies the following fundamental priorities for the country: (i) consolidation of public-sector reform; (ii) greater efficiency and competitiveness in the private sector; and (iii) better delivery of social services. The proposed project is consistent with items (i); (ii), and (iii).

1.26 The strategy for the sector mirrors the national strategy in supporting better agribusiness competitiveness internationally, through specific interventions such as support for the research system, and modernization of the infrastructure that serves agribusiness. The Bank has vast experience in supporting agricultural research, since EMBRAPA has implemented three earlier IDB-funded projects: Agricultural Development and Research in the Center-South Region, I and II (PROCESUL I and II); and Agricultural Technology Modernization of the Center-South (PROMOAGRO). The sector strategy also aims to promote rural development through infrastructure, productive, and social investments, with a view to incorporating the family farmer and small-scale rural entrepreneur into existing production and commercial chains. Examples of this type of support include the following projects: the Pernambuco Forest Zone Sustainable Development Program (BR0246); the Acre Sustainable Development Program (BR0313); and the Rural Settlements Consolidation Program (BR0274), all of which are currently under way. Considering the importance of the sector, the following projects are also being prepared: Sustainable Development for the Semi-Arid Sergipe Zone (BR-L1012), and Land Cadastre and Regularization (BR0392).

D. Program strategy

1.27 The program draws on lessons learned during the design and execution of various projects. The most recent EMBRAPA programs include (i) Agricultural Technology Modernization in the Center-South Region of Brazil (PROMOAGRO), funded by the Bank (1993-1999); and (ii) Agricultural Technology Development for Brazil (PRODETAB), financed by the World Bank (1996-2003). Both of these projects achieved their proposed target and objectives, and lessons were learned for the design of new operations. Preparation of this operation benefited from lessons learned in EMBRAPA programs and those executed by institutions from other countries of the region, as follows:

a. *In addressing short-, medium- and long-term research needs, a balance needs to be struck between financing through competitive funds and institutional strengthening* ("Competitive Grants in the New Millennium," Workshop financed by IDB and the World Bank, Brasilia, May 2000).

b. *Sustainable improvement of competitiveness and institutional change requires a comprehensive approach with private-sector participation* (PRODETAB).

c. *Programs to support the productive sector should include monitoring and evaluation capacity in the design stage* (Conclusions of various Bank projects, OVE).

d. *Agricultural research is profitable and generates economic impacts that repay the investments undertaken*. Projects financed by the IDB and the World Bank have a wide range of ex post and impact evaluations that report EIRRs ranging from 26% in family agriculture projects, to 146% in the case of cutting-edge technology projects.[1] The table below shows some of the work reviewed by the project team, which is available for consultation:

Evaluations of the impact of EMBRAPA projects during the 1980s

Project or study area	Authors	Period	IRR (%)
Agricultural Research Project - IBRD I - North/Northeast Region	Cruz & Avila	1977/82 1977/91	20 38
Agricultural Research Project - IBRD II - North/Northeast Region	Barbosa, Avila & Motta	1982/87	43
Agricultural Research Development in the Center-South Region - PROCESUL I & PROCESUL II	Avila, Irias & Veloso	1977/96 1974/96	27 38
EMBRAPA Research: Northern Region	Kitamura et al.	1974/96	24
EMBRAPA Research: Northeast Region	Santos et al.	1974/96	25
EMBRAPA Research: Center-West Region	Teixeira et al.	1974/96	43
EMBRAPA Research: Southern Region	Lanzer et al.	1974/96	45
Soybean Research Center - Return on total investment	Roessing	1975/82	45
Cotton Research Center - Return on total investment	Barbosa & Barros	1975/86	24
Wheat Research Center - Return on total investment	Ambrosi & Cruz	1974/82	59

Source: Avila & Souza, The Importance of Impact Assessment Studies for the Brazilian Agricultural Research System, 2002.

1.28 This operation has been designed to address key areas of agrifood research, to enable EMBRAPA to retain its position of pre-eminence and meet the increasing challenges facing the sector. Nonetheless, it is safe to say the capacity is there to implement a large-scale operation with high economic return, as shown by the studies listed above. The maximum size depends on the country's various priorities in a context of public resource constraints.

[1] PRODETAB – Project Appraisal Document, World Bank, 1997.

1.29 The program was designed to support strengthening of the National Agrifood Research System in priority areas for suitable development of agricultural activity and the rural domain. This is based on the fact that the State is responsible for providing basic public goods for development of a competitive sector (strategic research); creating conditions for more active private-sector participation in R&D, aimed at external trade (applied research); and incorporating innovations into productive processes. As has been the pattern in developed countries, R&D investment in Brazilian agriculture has generated high rates of economic return, which, if suitably targeted, could become an effective tool for raising export values and diversifying income sources in rural areas – key challenges for the Brazilian economy over the next few years.

E. Coordination with other development finance institutions

1.30 In the past, the IDB and the World Bank financed parallel operations with EMBRAPA, in which the IDB targeted the south and center-south of the country, while the World Bank focused on the northeast, north and center-west regions. Budgetary constraints since the early 1990s, however, led to a government decision to fund smaller operations through a single financier; so EMBRAPA has been alternating between the two banks, maintaining the same technical outlook since 1993, when the last operation with the IDB was approved.

II. THE PROGRAM

A. Objectives and description

2.1 The goal of the operation is to help improve the competitiveness of the agrifood sector, both in terms of food security in a context of equity, and in terms of export support. Its purpose is to strengthen the capacity of the agricultural innovation system in strategic areas that are crucial for agricultural and rural development. The project's specific objectives are as follows: (i) strengthening of R&D capacity for export diversification with high-quality and high-value products, and greater private-sector participation; (ii) modernization and updating of resources to serve strategic research areas; (iii) market access and integration of family production in agrifood and/or agribusiness chains; and (iv) a modernized management model with greater access to international knowledge.

2.2 To achieve these objectives, the program is divided into four components:

1. Competitive research and development system (US$14.18 million)

2.3 This component will finance applied research projects through a competitive mechanism in the following areas: (i) agroexport chains; (ii) agrifood health and quality support; (iii) preservation and exploitation of biodiversity; (iv) organic agriculture, hydroponics, and plasticulture; and (v) family agriculture. These areas were chosen from the 2004-2007 EMBRAPA Master Plan for their potential short- and medium-term impact, and because they are most likely to attract private-sector participation.

2.4 Project selection criteria and procedures are set out in detail in the operating manual. Projects will be executed by decentralized EMBRAPA units, which will be able to enter partnerships with OEPAs, universities, and private research centers, depending on the complexity of the projects and the skills of the participants involved. Apart for thematic areas that generate technology of an essentially public-good nature (i.e. yielding benefits that are hard for a small group of stakeholders to appropriate), research projects should be cofinanced privately. Items that can be financed in each project include equipment, inputs, consulting services, short training courses, travel, and per diems. As many as 135 projects are expected to be financed during the five years of the operation.

2. Capacity building in strategic areas (US$33.15 million)

2.5 This component will finance strengthening in areas relating to crosscutting research projects that are strategic in relation to the country's agrifood development, such as: (i) sustainability of natural resources in production systems; (ii) genetic resources; and (iii) biotechnology and biosafety. The component will also finance EMBRAPA capacity-building in aspects that impact most research areas: (i) intellectual

property and the marketing of technology products; (ii) monitoring, economic and socioenvironmental evaluation; (iii) good practices and infrastructure for environmental management in research centers and their laboratories; and (iv) information and communication system.

2.6 The key objectives for each strategic area are set out in the table below. Project investments include repairs, civil works, short- and long-term training, equipment, consulting services, and reference materials.

Strategic areas

	Strategic area	Goal
1	Natural resources	Strengthen research capacity for environmental management and sustainable management of production systems.
2	Genetic resources	Promote innovative processes based on genetic resources and contribute to the enrichment and availability of plant, animal, and microbial germoplasm.
3	Biotechnology and biosafety	Strengthen capacity for the use of genetic engineering techniques, and guarantee safe use of technology as required by biosafety regulations.
4	Intellectual property	Strengthen mechanisms for managing protectable knowledge, by upgrading, updating and providing skill training for EMBRAPA staff in the technical, legal, and economic aspects of intellectual property.
5	Socioeconomic and environmental monitoring and evaluation	Improve methodologies for evaluating the impact of technologies developed, and the efficiency of research units in their economic, social, and environmental dimensions.
6	Good laboratory practices and infrastructure for environmental management	Modernize research centers to improve environmental management of wastes, agrochemicals, and effluents; also upgrade their laboratories to guarantee the quality of studies with GMOs and other elements.
7	Information and communication system	Update information and communication technologies to improve the productivity of research and development activities.

3. Pilot information and technology management cluster for family agriculture (US$3 million)

2.7 In order to promote the creation of a technology market and productive organization, and to improve technology supply for family agriculture, financing will be provided to build three pilot clusters in regions of the country that have a high concentration of family farmers. Clusters will be located in Aurora (State of Pará), Valente (State of Bahia), and Dourados (State of Mato Grosso do Sul). These locations have been chosen according to the following MDA criteria: (i) concentration of family farmers; (ii) density of social capital; and (iii) existence of government, civil society, or municipal initiatives. Complementary criteria

include (i) initiatives by producer organizations; (ii) support from local authorities; (iii) connectivity and ease of access; (iv) infrastructure for the installation; and (v) proximity to an EMBRAPA unit. The land areas selected encompass a total of 72,200 farming families, who will be potential program beneficiaries.

2.8 The following cluster activities will be financed: (i) technology dissemination and promotion; (ii) promotion of technological research and management; (iii) information agency; and (iv) support for innovative and/or associative agribusiness management. The clusters should coordinate the process of identifying demand for applied research in their regions, and promote actions to ensure that the research requested is actually carried out both by EMBRAPA units and by state and/or university organizations. The clusters should have "wholesale" capacity to supply information and technologies to family producers and their productive organizations.

2.9 The component will finance the following activities: (i) investments in the information and communication system, including interconnection of clusters through the Internet, and training to manage them; (ii) ongoing training for multiplier technicians; (iii) organization of exchange events for farmers and technicians; (iv) studies of innovative business opportunities and evaluations of agribusiness proposals; and (v) activities for potential replication of successful experiences in other regions.

4. Support for regional and international integration (US$8.67 million)

2.10 This component will strengthen the growing inter-relationship between the Brazilian technological development system and other international partners (advanced research and development institutions in particular) based on priorities of common interest pre-established in bilateral agreements.

2.11 Support will be provided for: (i) specific activities undertaken by EMBRAPA Laboratories Abroad (LABEX) located in the United States (USDA-ARS), and in France (Agrópolis de Montepellier); (ii) technical cooperation with CGIAR international agricultural research centers; and (iii) the Regional Technical Cooperation Program with Institutions in the Southern Cone (PROCISUR), and a Technology Transfer and Research Cooperation Program for the South American Tropics (PROCITROPICOS). The program will fund joint research projects with EMBRAPA researchers and others from the abovementioned centers, through specific agreements with those institutions (see paragraph 3.32).

B. Cost and financing

2.12 The total cost of the program amounts to US$60 million equivalent, of which the Bank will provide US$33 million (55%) drawn from its ordinary capital. The local counterpart of US$27 million will be financed as follows: US$12 million from the national budget allocation to EMBRAPA, and US$15 million in funds generated by

EMBRAPA itself, of which US$4 million may be in the form of beneficiary contributions from component 1. The following table shows investment categories and financing sources.

Preliminary Costs of the Program
(in thousands of US$)

Categories	IDB-OC	Local	Total
1. Administration and supervision	**100**	**900**	**1,000**
1.1 Administration and management	0	300	300
1.2 Monitoring and evaluation	100	600	700
2. Direct costs	**32.900**	**26.100**	**59,000**
2.1Competitive R&D system	6.850	7.330	14,180
2.2 Basic capacity strengthening	17.450	15.700	33.150
2.3 Pilot clusters for family agriculture	1.100	1.900	3.000
2.4 Support for regional and international integration	7.500	1.170	8,670
Total	**33.000**	**27.000**	**60.000**
Percentages by source	**55.0%**	**45.0%**	**100.0%**

2.13 The terms and conditions of the loan from ordinary capital funds will be as follows: (i) adjustable interest rate; (ii) commitment fee of 0.25% per year on the undisbursed balance; (iii) five-year disbursement period; (iv) five-year grace period; and (v) 25-year amortization period.

III. PROGRAM EXECUTION

A. Borrower and executing agency

3.1 The borrower will be the Federative Republic of Brazil, with Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) serving as the executing agency. The latter is a public enterprise, attached to the Ministry of Agriculture and Supply (MAPA), with its own legal status under private law, its own assets, and administrative and financial autonomy. ***The signing and publication of an agreement for program execution between MAPA and EMBRAPA, in accordance with the model agreed with the Bank, will be a condition precedent to the first disbursement.***

3.2 EMBRAPA has 40 decentralized units, of which 37 are research centers and three are specialized services; its head office in Brasilia also has 11 central units. It has a presence in nearly all Brazilian states, and employs a staff of 8,619, of whom 2,221 are researchers, 45% with masters degrees and 53% with doctorates.

3.3 For program execution, EMBRAPA will be supported by a program coordination unit (PCU), attached to the Superintendency of Research and Development (SPD) and supervised by the Programming Management Committee (CGP) that already exists in the institution.

1. Program Coordinating Unit

3.4 The PCU will have an executive coordinator, an operational coordinator, and two area supervisors (one technical and the other in the management-financial area). In addition, a technical officer of the Strategic Management Secretariat (SGE) will be appointed as supervisor of monitoring and evaluation, with specific program support responsibilities. The Superintendent of Research and Development will be executive coordinator. The PCU will rely on existing EMBRAPA units (paragraph 3.8) in dealing with the various issues.

3.5 The PCU will have the following responsibilities: (i) management, monitoring, and evaluation of technical and administrative activities; (ii) preparation and presentation of annual work plans (AWPs) and semiannual progress reports for use in program management; (iii) proposal to the EMBRAPA Board of Executive Directors of corrective and alternative measures needed to fulfill project objectives; (iv) coordination with the Bank; (v) coordination with headquarters central units involved in project performance; and (vi) guidance to EMBRAPA units on the program's operating rules and procedures. ***Creation of the PCU and appointment of its members will be a condition precedent to the first disbursement***.

3.6 The **Executive Coordinator** will have the key function of ensuring program implementation, and reporting on the progress of components and activities to the Bank and to EMBRAPA management. The **Operational Coordinator** supports

and stands in for the Executive Coordinator, and also organizes and supervises the daily tasks of the Unit. The responsibilities of the **Technical Area Supervisor** include such matters as: (i) evaluating conformity of pre-proposals and proposals of projects to be funded by component 1; (ii) coordinating the hiring of program consultants with the Inter-American Institute for Cooperation on Agriculture (IICA); and (iii) monitoring compliance with the program's contractual clauses. The **Management-Financial Area Supervisor** will: (i) send payment requests approved by the technical adviser to the Financial Management Department (DAF); (ii) maintain program accounts and financial oversight; (iii) send disbursement requests to the Bank through the STN; and (iv) prepare financial statements and other reports as required by the Bank.

3.7 EMBRAPA will engage the IICA, using proceeds of the loan, to organize the hiring of program consultants, for a fee amounting to 4% of the amount actually spent on such hirings. The specific functions of the IICA will be as follows: (i) support for consultant selection; and (ii) contract management. For administration of the corresponding funds, the IICA will: (i) maintain special, separate bank accounts for IDB and local counterpart funds; (ii) implement and maintain suitable information systems for accounting and financial management of program expenses, integrated with official IICA accounting and the corresponding internal oversight structure, in order to manage Bank and local counterpart funds in accordance with Bank requirements; (iii) be accountable for eligible program expenses, and prepare and submit financial and operating reports as required by EMBRAPA; and (iv) maintain a suitable system for filing documentation in support of completed contracting processes and eligible expenses, for verification by the Bank and external auditors. ***The signing and publication of the contract between EMBRAPA and IICA, in accordance with the model agreed with the Bank, will be a condition precedent to the first disbursement***.

2. Participating departments and units

3.8 As indicated in paragraph 3.4, technical and administrative execution activities will be channeled through the existing EMBRAPA institutional structure, with technical and operational functions distributed as follows: (i) the Strategic Management Secretariat (SGE) will be responsible for monitoring logical framework indicators, together with the midterm and final evaluations, and specific studies for the program; (ii) the Planning and Monitoring Coordination Unit (CPA/SPD) will be responsible for evaluation of the technical and scientific merit of the program's projects and activities; (iii) the Institutional Relations Coordination Unit (CRI/SPD) will be responsible for execution of component 3; (iv) the International Cooperation and Coordination Unit (CCI/SPD) will be responsible for the execution of component 4; and (v) the National Environmental Research Center will assist the PCU with the environmental aspects of program activities.

3.9 Operational support units are as follows: (i) Staff Management Department (DGP), responsible for staff training activities; (ii) Materials and Services Administration

Department (DRM), responsible for goods and services procurement and asset control; (iii) Information Technology Department (DTI), responsible for the development and implementation of information technology systems, including launching of the PCU/SPD website, and modernization of the corporate information and communication system; and (iv) the Financial Management Department (DAF), which will assist the PCU with the financial management and accounting procedures required by the Bank for program execution.

3. Programming Management Committee

3.10 The CGP, created through Regulatory Decision 13 of 19 December 2002, consists of 19 members, including two executive directors and another 17 members chosen on a rotating basis from managers and researchers in central and decentralized EMBRAPA units, and chaired by one of the executive directors. The mission of this committee in relation to the program is: (i) to analyze and evaluate program progress; (ii) to review priorities during execution; (iii) to approve annual program work plans (AWPs); (iv) to ensure private-sector participation; and (v) to guarantee the local counterpart contribution to carry out the work program.

B. Execution mechanism by component

1. Financing of applied research projects

3.11 Execution of this component will be based on the management systems currently in place in EMBRAPA for competitive project selection. Execution will be governed by an operating manual, the most relevant aspects of which are described below. ***Implementation of the operating manual will be a condition precedent to the first disbursement.***

3.12 Applied research project proposals will be restricted to the topics indicated in the five strategic areas mentioned in paragraph 2.3. EMBRAPA researchers are eligible to submit project proposals, preferably in partnership with other research institutions. Proposals should contain a private-sector counterpart of at least 25%, except in cases relating to the preservation and exploitation of biodiversity and family agriculture.

3.13 At least two calls for project proposals will be made annually. Proposals will be sent to the PCU for verification that they conform to the specifications of the tender. All proposals satisfying such verification will be sent to the CPA/SPD, which coordinates the scientific and technical merit evaluation through technical committees.

3.14 These committees consist of professionals recognized in their field in the technical and scientific community, supported by at least two ad hoc reviewers per project. Criteria for the technical and scientific merit evaluation are as follows: (i) consistency with the thematic areas of the tender; (ii) private-sector participation; (iii) structure and content; (iv) methodological suitability; (v) budgetary suitability;

(vi) technical and scientific aspects; (vii) socioenvironmental evaluation; and (viii) general project quality and the chances of objectives being fulfilled within the established timeframe.

3.15 The results of the technical and scientific merit evaluation are submitted to the Programming Management Committee (CGP) for a final decision. This committee may reject or approve the proposal, with or without reformulations. CGP decisions are placed on the PCU/SPD website and sent with justifications to project team leaders and heads of units. Following modification, projects that were approved subject to reformulation must be returned to the Technical Committee for evaluation and to the CGP for final approval. The PCU prepares implementation agreements to be signed with the execution units and the lead researcher of the project. The funding will be released and project reports submitted as indicated in the approved proposals. Projects will be monitored by the Technical Committees and the PCU.

3.16 Proposals will be processed through a web-based electronic system, which will make it possible to complete project forms on-line, as well as the entire process of ex ante evaluation, technical monitoring, contracting, and administration.

2. Strategic research

3.17 Each strategic area has a technical and financial proposal containing objectives, targets, indicators, detailed budget, and outcomes, which was reviewed and evaluated by the Bank team (RE1/EN1 files). EMBRAPA will appoint a coordinator for each area, who will organize execution according to the budget and timetable contained in the proposal.

3.18 In October each year, the PCU will ask each coordinator to submit their annual plan setting out activities for the following year, based on the technical and financial proposal, together with the investments and resources needed and an indication of resources committed up to the year of presentation. The PCU, assisted by the CPA, will analyze these annual plans for consistency with the original project, and submit them to the CGP along with the annual plans of the entire program for final approval.

3.19 Once the plan has been approved by the CGP, the PCU will notify the corresponding coordinator and authorize execution thereof, sending requests to the EMBRAPA headquarters unit concerned according to the type of investment required (e.g. training to the DGP). The PCU will verify fulfillment of activities and achievement of outcomes through its monitoring system.

3. Pilot information and technology management cluster for family agriculture

3.20 This component will be executed by the Institutional Relations Coordination Unit (CRI/SDP), which will appoint a component coordinator. EMBRAPA will sign

specific agreements for the work in the respective clusters. Participating institutions will be national organizations (the Brazilian Micro and Small Business Support Service - SEBRAE) and the Ministry of Agrarian Development (MDA); together with state bodies, civil society organizations, and institutions whose work with family agriculture is relevant in the area of the cluster in question. ***The signing and publication of agreements between EMBRAPA and organizations participating in the three clusters will be a condition precedent to the disbursement of more than 10% of the total amount of the financing.***

3.21 Each cluster will establish the following: (i) a work team consisting of four professionals (one of whom acting as coordinator) and an administrative assistant, attached to EMBRAPA and the participating organizations; and (ii) a Cluster Committee to monitor and evaluate the work of the cluster, formed by representatives of participant and producer organizations.

3.22 The cluster work team will: (i) prepare annual work plans and monitor the execution of cluster activities; (ii) organize training workshops and technical visits; (iii) prepare specifications for information materials; (iv) identify and implement forms of communication that are suited to the characteristics of the region; (v) survey and address the demands of family farmers; (vi) promote farmers' access to information technology; (vii) provide specialized consulting services for agribusiness management; and (viii) identify a network of multipliers formed by technical workers and agricultural leaders attached to participating organizations, who will help spread the use of information, knowledge and technologies by family farmers.

3.23 The annual work plans of each cluster will be approved by the respective Cluster Committee and included in the Annual Component Plan to be submitted to the PCU in October each year. The Annual Component Plan must list activities for the following year, together with the investments and resources needed and an indication of all commitments made so far during the program. The PCU will verify consistency between the consolidated annual plan and the original project, and submit it to the CGP for final approval. Once the annual plan has been approved, the PCU will notify the coordinator and authorize execution thereof, forwarding requests to the corresponding EMBRAPA headquarters unit according to the type of investment required. The PCU will verify fulfillment of activities and achievement of outcomes through its monitoring system.

4. Support for regional and international integration

3.24 This component will be executed by the International Cooperation Coordination Unit (CCI/SPD), which will appoint a component coordinator. EMBRAPA will sign agreements to implement specific research activities with: (i) the United States Department of Agriculture (USDA-ARS) and with Agrópolis de Montepellier in France, to expand the activities of Laboratories Abroad (LABEX); (ii) CIAT to undertake research activities with CGIAR international research centers; and

(iii) the IICA, for Regional Technical Cooperation Programs with Institutions in the Southern Cone (PROCISUR) and its equivalent in the Amazon region, the Cooperative Program on Research and Technology Transfer for the South American Tropics (PROCITROPICOS). ***The signing and publication of contracts with USDA-ARS, Agrópolis, and CIAT will be a condition precedent to the first disbursement.***

3.25 EMBRAPA will select researchers to participate from LABEX teams in the United States and France, though a competitive process. The program will finance their travel and accommodation, including the costs of carrying out research in the respective workplaces and attendance at seminars and refresher courses.

3.26 The areas of LABEX research will be: (i) bioinsecticides and other pest management techniques; (ii) new uses of commodities and value-added; (iii) global climate change; (iv) genetic improvement; (v) biotechnology; (vi) agrifood and agribusiness technologies; (vii) natural resource management; and (viii) agricultural economics. Final reports including the outcomes of each LABEX unit are evaluated by the Boards of Directors of EMBRAPA and the cooperating institution (USDA/ARS and Agrópolis-Montpellier) and made available to all SNPA researchers.

3.27 The program will finance cooperation between EMBRAPA and CGIAR in the following areas: (i) prevention and recovery of degraded areas through policies and technologies for sustainable development of the Amazon region; (ii) development of agribusiness competitiveness and sustainability in products of animal origin; (iii) support for the development of agribusiness in products of plant origin; and (iv) modernization and rationalization of family farming processes. EMBRAPA and CIAT will sign a cooperation agreement specifying the responsibilities and obligations of the parties. CIAT will manage resources in response to requests submitted by EMBRAPA as indicated in the annual work plans.

3.28 EMBRAPA currently has two cooperation agreements under the regional PROCISUR and PROCITROPICOS programs. These have been signed by the research institutions from each country and the IICA, as administrator and coordinator of each program. In the PROCISUR framework, this component will support EMBRAPA participation in research activities set in the following technological platforms: (i) functional genome; (ii) quality of chains; (iii) environmental sustainability; (iv) organic crops; and (v) family agriculture. In PROCITROPICOS, the component will support EMBRAPA participation in the following subprograms: (i) biodiversity, conservation, and sustainable use of genetic resources; (ii) sustainable management of natural resources; (iii) production and dissemination of agricultural information; (iv) rural agribusiness; and (v) institutional sustainability. The IICA will administer the resources contributed by EMBRAPA (from the program's local counterpart), as indicated in the annual work plans.

3.29 In October each year, the component coordinator will present the annual plan to the PCU, listing the activities for the following year, together with the investments and resources needed and an indication of all commitments made up to that time. The PCU will analyze the consistency of the plan and submit it to the CGP for final approval.

3.30 Once the plan has been approved, the PCU will notify the coordinator and authorize execution thereof, forwarding requests to the corresponding EMBRAPA headquarters unit according to the type of investment required. The PCU will verify fulfillment of activities and achievement of results through its monitoring system.

C. Procurement of goods and services

3.31 Goods and services will be procured and consulting services engaged in accordance with Bank policies and bidding procedures. International competitive bidding will be required for works where the estimated cost is equivalent to US$5 million or more, and for goods and services costing US$350,000 or more. All consulting services contracts in amounts equivalent to US$200,000 or above will also be subject to international competitive bidding. Contracts for goods and services will be awarded in accordance with the procurement plan. Documentation in support of goods and services procurement and contracting will be reviewed on an ex post basis.

D. Exceptions to Bank policy

3.32 For execution of the regional and international integration support component, an exception is proposed to the competitive bidding procedure to allow direct hiring of USDA-ARS, Agrópolis of Montpellier in France, and CIAT in Cali, Colombia.

3.33 Justification for direct hiring of the aforementioned institutions is based on their technical and institutional advantages which are internationally recognized in the agricultural research area. In the specific case of USDA-ARS, the justification stems from the fact that the United States is an important market for Brazilian agricultural products; both countries have similar production problems in the area of pests and animal and plant diseases; and the fact that they have opposite seasons helps to lower the costs of shared research projects. Agrópolis is Europe's largest center of excellence in agricultural sciences, and host to the largest number of researchers in this field, encompassing not only French research institutes specializing in tropical and temperate agricultural conditions, but also research agencies from other European countries. As an organization, CIAT is the main CGIAR research center in tropical agriculture, and it has a long track-record of working with EMBRAPA. It also acts as a link for relations with other international research centers in the CGIAR system, enabling EMBRAPA to carry out research activities in all areas of agricultural technology.

3.34 As an exception to normal bidding procedures, IICA will be hired as a specialist executing agency to administer the program's consulting services. This is justified by its technical and institutional advantages, wide-ranging management experience, and its effective capacity to select and hire consultants in agrifood areas, as proven through actions supporting the execution of external loans received by EMBRAPA.

E. Reimbursement of expenses charged against the financing

3.35 The Bank may reimburse up to US$300,000 equivalent against the loan, in respect of expenses incurred by the executing agency to implement the program management, monitoring, and evaluation system provided they conform to Bank procedures and policies, and the provisions established in the loan contract and its annexes, and provided they have been incurred within 18 months prior to the date of loan approval (and after the operation has been officially admitted to the project pipeline).

F. Execution period and disbursement schedule

3.36 The following table shows the disbursements schedule envisaged for the program during its five years of execution:

Disbursement schedule by year of execution
(in thousands of US$)

Financing source	TOTAL	Year 1	Year 2	Year 3	Year 4	Year 5
1. IDB	**33,000**	3,600	7,400	9,200	9,200	3,600
2. Local	**27,000**	3,000	6,200	7,400	7,400	3,000

G. Revolving fund and audit

3.37 In order to make funds available in advance for carrying out activities to be financed out of the Bank financing, a revolving fund will be created for up to 5% of the loan amount. The executing agency will present to the Bank a semiannual report on this fund within 60 calendar days following the end of each six-month period.

3.38 During program execution, EMBRAPA will submit annual financial statements for the program and the institution itself. The external audit will be carried out by independent auditors acceptable to the Bank (Federal Oversight Secretariat), in accordance with the requirements set out in documents AF-100 and AF-300, and based on terms of reference previously approved by the Bank (document AF-400). The audited financial statements for the program and EMBRAPA will be presented within 120 days after the end of each fiscal year, and those submitted upon completion of the program within 120 days after the final disbursement.

H. Management, monitoring, and evaluation

3.39 The program's management, monitoring and evaluation system will be based on EMBRAPA's existing management information system, which will be adapted to provide up-to-date information on program management and for management decision-making by the PCU and program beneficiaries.

3.40 The system will make use of a master management and information database containing basic information on program monitoring, management, and impact indicators. This will be constructed in modules to capture the different information needs of each user group, and it will contain information on household surveys. The system will be able to capture data and export information to and from external environments; and it will have the capacity to generate standard information (predefined and available by menu), as well as custom-made (constructed by a specific user from the data in the system). It will be developed in three modules: (i) a specific module for component 1, which will allow all project processes to be carried out online, including presentation of proposals, their evaluation, approval, contracting, and management; (ii) a second module to manage the other three components, which will permit administrative monitoring of each component's annual plans; and (iii) another module containing information from the program's logical framework (Annex II-1), which will allow technical monitoring, midterm and final reviews, and specific studies. The SPD will hire a consultant to adapt program requirements to the general EMBRAPA system. ***Implementation of the component 1 administration module is a condition precedent to disbursement, and no more than 20% of the total loan amount may be disbursed until the monitoring and evaluation system has been implemented to the Bank's satisfaction.***

3.41 The Strategic Management Secretariat (SGE) is responsible for evaluation; it will appoint a technical expert to carry out this task and coordinate specific strategic studies for the evaluations envisaged in the program, including those on potential impacts. On-site visits will be made to discuss project execution with the teams involved, to obtain a precise view of problems encountered and the outcomes. Learning activities will also be carried out, such as workshops to disseminate knowledge gained during project execution; seminars to discuss the outcomes of studies; and skills training on program monitoring and evaluation. Evaluation activities will be made available through links on the websites of the program and RE1/EN1.

3.42 Either 30 months after the contract has entered into force or when 35% of the funds have been disbursed, whichever occurs first, the PCU and the Bank will undertake a midterm program review. This will consider: (i) progress in attaining program targets; (ii) the effectiveness of the competitive mechanism for selecting applied research projects (including correct application of all project selection criteria); (iii) the private-sector share of funding for applied research; (iv) progress in implementing activities to strengthen strategic areas (especially outcomes arising

from the execution of projects on "good laboratory practices", and civil works aimed at controlling agrochemicals, chemical waste, and sanitary effluents, and those of animal origin); (v) evaluation of pilot experiences in family agriculture (including data on women's participation and activities carried out with indigenous communities); (vi) outcomes achieved in international cooperation agreements; and (vii) effectiveness of the program monitoring and evaluation system, and identification of possible lessons learned.

3.43 When 90% of the loan proceeds have been disbursed, the PCU and the Bank will conduct a final program review, to include (i) evaluation of the economic, social and environmental impacts of a representative sample of technologies developed in projects selected through the competitive system; (ii) a specific evaluation of each component, estimating the potential impacts of technical programs and investments financed; (iii) possible measures to make program activities sustainable, particularly to ensure the continuity of family agriculture experiences and international cooperation; and (iv) identification of lessons learned through implementation and use of the monitoring and evaluation system, together with potential uses of the system for other operations. Specific studies will also be conducted during execution to support the project evaluation process, with the following provisionally identified: (i) after three months of execution, determination of the baseline in areas where the three family agriculture clusters will be installed; and (ii) evaluation of the work of each cluster 18 months after installation, including consultations with cluster users. The final review will form the basis of the program's project completion report (PCR).

3.44 In accordance with Bank policy, EMBRAPA, through the PCU, will compile, store, and maintain all data, indicators, and parameters needed to assist the Bank in preparing the PCR, including annual work plans, and midterm and final reviews.

IV. VIABILITY AND RISKS

A. Institutional viability

4.1 EMBRAPA has demonstrated its institutional capacity to execute externally financed projects in a number of operations. The most recent project executed with Bank funds, the Agricultural Technology Modernization Program in the Center-South Region of Brazil (loans 671/OC-BR and 878/SF-BR), gained satisfactory ratings throughout the execution period in terms of implementation progress, with a high probability of fulfillment of its development goals.

4.2 EMBRAPA has the institutional organization, skilled staff, infrastructure and procedures needed to execute the technical activities envisaged for the project, and also for their technical and socioeconomic evaluation and supervision, and for administrative and financial oversight.

4.3 Satisfactory leadership of the program is assured by putting program direction and coordination in the hands of the Superintendency of Research and Development, EMBRAPA's senior management body, responsible for technological research and development and the technical supervision of decentralized units. EMBRAPA will also set up the program's PCU, which will help to facilitate the flow of information from decision-making to the execution and monitoring of activities. The unit will be supported by the various EMBRAPA mechanisms, including its Board of Executive Directors, headquarters support units, and decentralized units. These measures will ensure the operation's institutional viability.

B. Socioeconomic viability

4.4 The results of numerous ex post evaluations show that investment in agricultural research in Brazil has produced a high economic return, and that EMBRAPA has been able to exploit its important niche as a tropical agriculture research institution. Since 2001, the institution's Strategic Management Secretariat (SGE) has undertaken systematic surveys of the economic impact of the technologies generated by its units, and in 2003 the aggregate economic impact (120 selected technologies) was estimated to be the equivalent of 8.7 times the institution's total budget.

1. Methodological strategy

4.5 Notwithstanding the ex post economic impact, which has been widely documented, an ex ante estimate of economic returns is inherently difficult in the case of R&D activities, given the uncertainty surrounding the impact of solutions found, and when they actually occur. A further methodological challenge is posed by the nature of the program, which aims to improve the productivity of an organization that is already functioning, by making investments in critical areas, and in relatively

small amounts compared to the institution's budget. The resources that finance R&D costs, for example, are channeled through a competitive fund within fairly broad guidelines, which makes it hard to define expected economic impact scenarios attributable to the program. Despite these constraints, however, the economic evaluation aims: (i) to assess the capacity displayed by EMBRAPA to generate technologies of significant economic impact in the program's broad thematic areas (diversification of exports and integration of family agriculture into agrifood chains – component 1); and (ii) to analyze the economic return on investments in basic capacity strengthening, in terms of cost savings or increased institutional productivity (component 2).

2. Cost-benefit analysis of a sample of technologies

4.6 In order to analyze the capacity of EMBRAPA to generate technologies for family agriculture and in recent or emerging export product lines, an evaluation was made of a sample of 14 technologies launched in the last few years by 10 centers. Economic impacts were calculated using the economic surplus methodology, measured in terms of cost reduction, productivity increase, or higher production value. Using information provided by the centers, it was also possible to calculate the costs incurred by EMBRAPA in technology generation and transfer, the percentage attribution of benefits, and adoption levels, observed and expected. Uncertainty as to the path to be followed by future adoption and attribution of benefits was analyzed through Monte Carlo simulations, with percentage attribution and the parameters of a logistics projection (S curve) as random variables. When net present value (NPV) and the expected cost-benefit ratio (BCR) were calculated using this methodology, the estimated BCR for the technologies analyzed varied between 1.1 and 93.9, with an overall average of 13.9.[2] In other words, for each dollar invested in the development of these technologies, the country would have obtained a net return of US$12.9.

3. Ex ante analysis of the key investments in basic capacity strengthening

4.7 As the program prioritizes strengthening in areas that have a crosscutting impact on technology generation capacity, the analysis focuses on investments in conservation and genetic improvement, and on updating and improving the information and communications system, because they account for a substantial share of program costs (71% of component 2 costs), and quantifying the corresponding economic impacts is of little relative difficulty. The economic benefits of investments in genetic resources in conservation, characterization, and pre-enhancement are closely related to those aimed at increasing the productivity of the enhancement effort through conventional and biotechnological means. The expected present value of new accesses to a gene bank depends crucially on the time needed for searching and incorporating useful genetic material, in varieties that are adequately

[2] The benefit-cost ratio is defined as 1+NPV/PVC, where PVC corresponds to the present value of generation and transfer costs incurred by EMBRAPA, at December 2002 prices.

adapted to production conditions. The contribution and economic value of gene banks has proven to be significant when accesses are viable and distinguishable.

4.8 The program supports capacity strengthening for conservation, characterization, and intensification of the use of genetic resources. A gene bank with greater genetic diversity, and improved conservation and characterization techniques, will have an impact on the firm's enhancement programs, both directly and through greater exchange of genetic material with other sources. Genomic and proteomic investments will also help to raise the productivity of the enhancement effort and shorten the time needed to launch new varieties. A 5% reduction in the time needed to launch the main varieties of EMBRAPA's conventional genetic improvement program would be sufficient to justify such investments.[3] Assuming a triangular distribution function for the time reduction variable, with a most likely value of 10% and maximum value of 25%, the expected NPV is 33.6 million, and the BCR is 5.8.

4.9 The training, equipment and infrastructure investments funded by the program would provide EMBRAPA with the capacity to carry out the biosafety tests required by the regulations and make it viable to launch genetically modified varieties. The economic impact of these investments is highly dependent on the way the regulations evolve, however. The potential benefits at stake, considering products scheduled for launch during the next 10 years (virus- and insect-resistant) were estimated at US$177.3 million. A one-year reduction in launch time, attributable to the program (in the virus- or insect-resistant product group), is sufficient to justify investments in biosafety and biotechnology. The expected NPV and BCR are US$53.2 million and 7.6, respectively.

4.10 Efficient data transmission and videoconferencing are fundamental in institutions such as EMBRAPA with units scattered over a wide geographic area. The significant growth in information traffic has accelerated the rapid obsolescence experienced by technologies currently in use. Modernization of the network in 36 units, through appropriate segregation, will make it possible to reduce the transfer time faced by researchers by a total of 12,362 days per year, or 3.5 days per researcher. Valuing time in terms of staff remuneration including social contributions, the benefit to EMBRAPA from network improvement amounts to US$5.8 million. The expected NPV and BCR of this investment are US$2.7 million and 1.93, respectively.

C. Financial viability

4.11 Responsibility for the loan and corresponding debt service rests with the Federative Republic of Brazil, which will sign a contract as borrower and also guarantee

[3] In the case of varieties scheduled for launch over the next 10 years, the average estimated launch time is eight years.

annual budgetary appropriations to cover interest payments, loan amortization, and any additional charges.

1. Capacity of counterpart contribution

4.12 According to the consultation letter approved by the External Financing Commission (COFIEX), 20% of the total project cost (US$12 million) will be financed by the National Treasury through the annual EMBRAPA budget; 15% (US$9 million) will be contributed by EMBRAPA itself, and the remaining 10% is the responsibility of EMBRAPA but may be contributed by the beneficiaries. In view of this directive, the program's financial viability was analyzed from three standpoints: (i) the availability of Treasury resources for the local counterpart in the EMBRAPA budget; (ii) the financial capacity of EMBRAPA to provide internally generated funds to cover its share of the local counterpart and the program beneficiaries' contribution; and (iii) the possibility of obtaining a contribution from program beneficiaries themselves.

The issue of internally generated revenues

During preparation of the PRODETAB operation with the World Bank, revenue generated by EMBRAPA itself accounted on average for 7% of its budget, and the agreed target involved raising this proportion to 12% in 2000 and 15% in 2002. Although a level of 14.2% was achieved in 2002, the figure dropped back to 13.3% in 2003. As PRODETAB accepted the cofinancing of competitive projects as internally generated revenue, the target envisaged for this project was comfortably achieved.

4.13 National Treasury resources for the local counterpart come from budget line 2.100 - Ordinary Treasury. For analytical purposes, the firm's budgets for 2000-2003 were reviewed, together with the budget for fiscal 2004 and budget line projections corresponding to the counterpart of the AGROFUTURO project in the 2004-2007 multiyear plan (PPA). The PPA review confirmed that resources have been assigned to guarantee the necessary funding for program execution, although adjustments will be needed to adapt to the new project execution period of 2005-2009. This involves an additional amount of nearly 1% in annual Treasury transfers to EMBRAPA for a five-year period, at current prices.

4.14 An evaluation was also made of the enterprise's capacity to provide the US$15 million counterpart from its own revenues. The firm's accounts contain two types of internal revenues: the first is shown in source 0.250 – **Direct Revenue**, from the sale of services and seeds, together with royalties for third-party use of its research results. This revenue source averages US$13.7 million per year (2002-2003), accounting for 5% of total EMBRAPA revenue. The second category of internally generated income, classified as **indirect revenue**, comes from agreements or contracts for research projects or specific events, and is usually paid by private institutions, universities, and foundations. This revenue source averaged US$19.1 million per year in 2002-2003 (i.e. 8% of the institution's average total annual income). Assuming the average level of internally generated revenues of the last few years is maintained, the forecast for the next five years is on the order of US$160.8 million, which provides more than enough to guarantee the

US$15 million local counterpart out of internally generated resources during the AGROFUTURO execution period.

4.15 AGROFUTURO will also have participation from beneficiaries and other institutions involved in the components for Financing of Applied Research Projects and the Pilot Information Technology Management Cluster for Family Agriculture, which represent supplemental contributions of national or additional counterpart funding, estimated at US$4 million. As far as the Bank is concerned, if the private-sector contribution cannot be assured, the corresponding amount should be guaranteed by EMBRAPA.

2. Authorization for borrowing

4.16 As to obtaining revenue through external borrowing, a total of US$25.7 million was assigned in the 2004-2007 PPA, compared to expected disbursements of US$20.2 million. The total amount envisaged for the project is US$33 million up to 2009. Hence in the annual PPA reviews and in the new PPA (2008-2011) EMBRAPA will need to seek a review of the amount and an adjustment in the repayment term. The total contribution made by the financing will be equivalent to 2.9% of the annual EMBRAPA budget.

3. Budget, financial situation and prospects

4.17 The annual EMBRAPA budget averaged US$279.7 million in 2000-2004, funded almost entirely by the National Treasury. Treasury transfers to EMBRAPA, which are not financially reimbursable, accounted for US$245.8 million or 95.3% of the total 2004 budget of about US$257.9 million, excluding the firm's indirect revenue estimated at US$18.8 million. Treasury resources are destined for: (i) full payroll expenses, US$161.4 million (63%); (ii) current expenses, US$57.9 million (22%); (iii) investments, US$12.1 million (5%); and (iv) debt service, US$26.5 million (10%).

4.18 EMBRAPA is subject to the same controls as the government imposes on foundations and decentralized agencies. Budgetary legislation requires such institutions to prepare and execute their budgets under the control of the federal government's Budgetary Data System (SIDOR) and Integrated Financial Management System (SIAFI), which guarantees a regular financial flow of budgetary appropriations to the program.

D. Environmental and social impacts

4.19 The program's potential social and environmental impacts were evaluated from two standpoints: (i) potential direct impacts of research carried out in laboratories and in the field; and (ii) potential long-term indirect impacts of technologies generated and eventually adopted.

4.20 To evaluate the possible direct impacts of research projects, environmental management was analyzed in a sample of experimental centers (laboratories, experimental fields, and support activities). The analysis confirmed that all EMBRAPA activities with GMOs comply with current national legislation (which requires detailed environmental impact and food safety studies before commercial release of any GMO); and that they also satisfy the biosafety standards of the National Technical Commission on Biosafety (CTNBio), whose regulations are broadly in line with international standards. No situation of inadequate containment was detected; nonetheless, some centers need to improve their access control systems, written policies and procedures, and record-keeping; and the program will help them to do so.

4.21 Other potential direct environmental impacts of the operation stem from the use of toxic substances; the production of solid, liquid, biological, and chemical wastes; and support activities such as the application of agrochemicals, and the maintenance of vehicles and field equipment. Some of the centers in the sample are already implementing programs to improve environmental management and minimize negative environmental effects; and this operation will finance a set of improvements (infrastructure, equipment, inputs, and technical assistance) to promote better environmental management. Funding will be provided to construct: (i) deposits for storage and appropriate handling of pesticides in all centers that use them; (ii) deposits for storage and correct handling of chemical wastes from laboratories in all centers; (iii) three animal effluent treatment systems; (iv) four domestic effluent treatment systems; and (v) technical assistance, equipment, remodeling, and training to certify 12 biotechnology laboratories in good laboratory practices.

4.22 Potential indirect impacts from the implementation of technologies developed with funding from this operation were evaluated by reviewing: (i) project types approved in PRODETAB, a program financed by the World Bank; (ii) the results of an environmental impact assessment of the sample of EMBRAPA technologies (carried out for the same technologies evaluated in the cost-benefit analysis); and (iii) EMBRAPA research lines and objectives and the types of projects prioritized in component 1. The results of the analysis showed that in most cases the technologies are designed to minimize negative impacts – for example, by taking advantage of varieties that are better adapted to climatic conditions or pest-resistant, developing organic agriculture practices, supporting techniques in rational water use, comprehensive pest management, or improving productivity and minimizing input use in areas used for crop and livestock activities. In the sample of evaluated projects, all technologies proved to have a generally positive or neutral environmental impact, since they facilitated better environmental management and benefited family agriculture. Nonetheless, certain technologies may cause negative indirect environmental and social impacts.

4.23 To ensure environmental and social impacts are appropriately considered when selecting competitive projects, the operating manual for component 1 requires each

project bid to identify potential impacts and design measures to overcome negative ones. Socioenvironmental impact is one of the criteria used in the evaluation and ranking of proposals in terms of their technical-scientific merit.

4.24 Given the emphasis on developing technologies for family agriculture, the social impacts of the operation ought to be positive. In component 3, initial surveys will be carried out to characterize and motivate families living in the cluster area, paying special attention to women's needs. Monitoring programs will also be implemented to evaluate women's participation in cluster programs. It is possible that one of the clusters will be located in a state with indigenous communities, in which case programming will take into account considerations of language and cultural practices for information and program development. Information agency activities will include good environmental practices, hygiene and safety with agrochemicals, waste management, and environmentally sustainable alternatives, such as comprehensive pest management and organic farming.

4.25 The program will finance the development and application of a methodology to evaluate technologies using a combination of AMBITEC-AGRO (a methodology developed by the EMBRAPA environment unit), social impact indicators, and more objective environmental indicators, which will be integrated into the program monitoring and evaluation system.

E. Expected benefits and beneficiaries

4.26 The program will boost productivity in Brazil's agricultural R&D system, particularly in the process of innovation in order to open up new export markets and the integration of family producers into production chains. The main beneficiaries will be the producers who incorporate these technologies, since they will be able to reduce their production costs and/or raise product prices. Other major beneficiaries of technological innovation will be economic agents in the remaining links of the production chain, including the input producer industry and agribusiness processing, and this will generate better job opportunities in both rural and urban areas. Consumers will also derive significant benefits from innovation in products aimed at domestic markets.

F. Risks

4.27 The main risks associated with the program are as follows: (i) lack of interest in helping to cofinance technology generation services; and (ii) difficulties in obtaining support from other institutions to implement the Pilot Information and Technology Management Cluster for Family Agriculture component. The program addresses the first of these risks by means of a competitive mechanism to encourage private-sector cofinancing for applied research projects. The second risk is likely to fade, given the results being obtained by the executing agency in coordination meetings held with sector institutions for joint activities in the pilot family agriculture clusters.